
Space Weather Technical Forecast

Issued on Friday, 14 January 2022 at 00:51 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: G1/Minor Storm intervals likely, most probably day 2 (15th). Solar activity probably increasing through the period as far-side regions rotate into view.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low in the last 24 hours, with several C-class flares. The largest flares were observed around 13/0200 and 13/1200UTC from over the northeastern limb. These may have been emitted by previous region AR2821, which is due back onto the Earth-side during the next 24 hours.

There are currently six active regions on the Earth-side, however no notable flares have been observed from these regions. AR2924 remains the largest region, currently classified at Fai/beta , but has been inactive. The remaining regions are Alpha/beta regions, magnetically simple, small, weak and stable.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE and DSCOVR at L1 are now slow-ambient around 350 km/s with brief incursions above 400 km/s (becoming slightly elevated). The density of the wind was at or below average. Total interplanetary magnetic field (IMF) strength, Bt, was weak, peaking 6nT, with the Bz component also varying weakly between -4 and +5 nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at predominantly background levels, temporarily reaching moderate levels of 137 pfu. Electron fluence gently declined, well below the Active threshold ($1\text{e}8$ integrated pfu), with $1.41\text{e}6$ integrated pfu recorded at 14/0000 UTC.

Four-Day Space Weather Forecast Summary

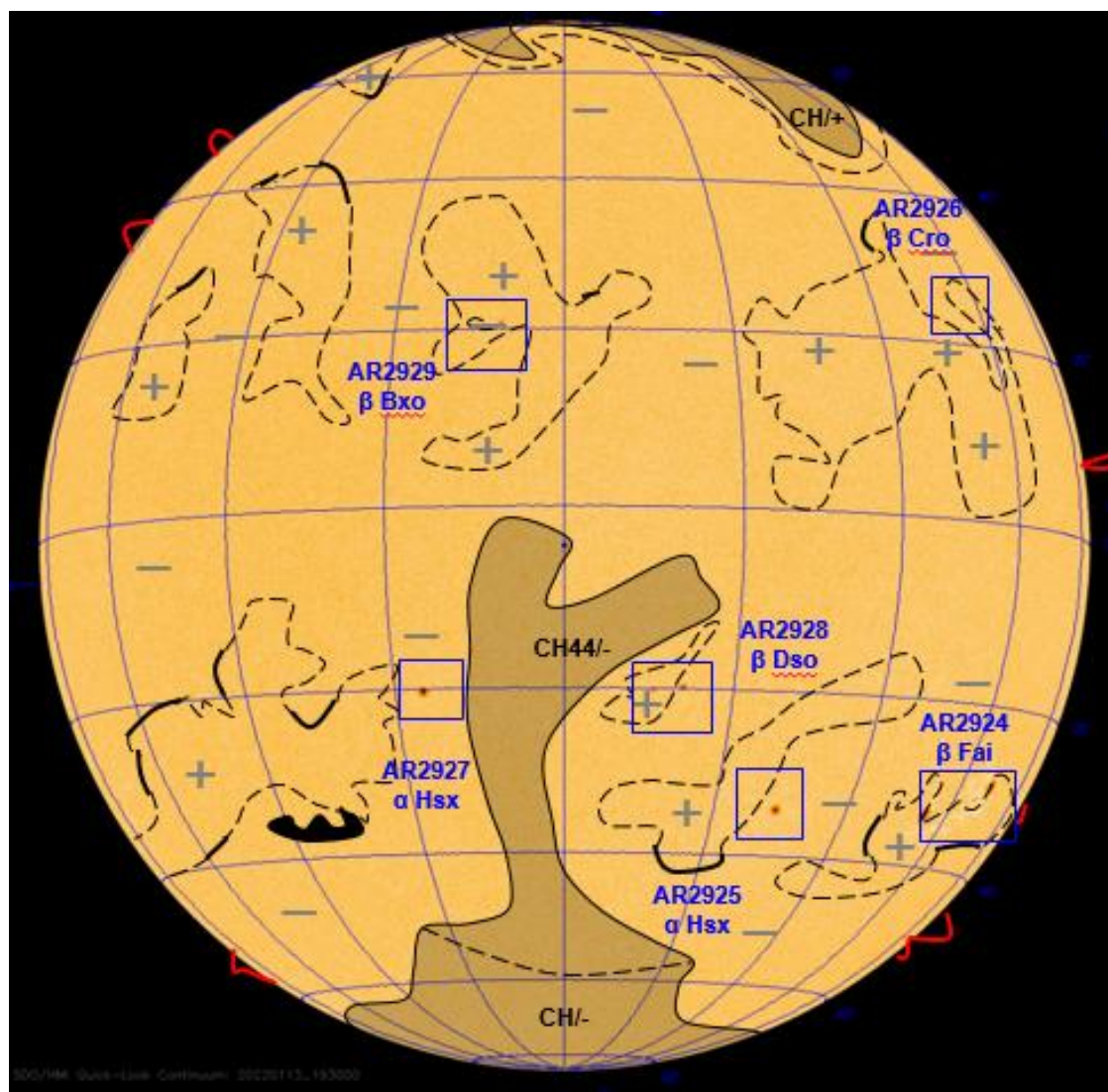
Solar Activity: Solar activity is expected to be Low or Very Low, with a slight chance becoming moderate. This risk increasing a little by day 2 (15th) as far-sided regions approach or move around the eastern limb.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slow-ambient solar winds are likely until the arrival of the high speed stream (HSS) related to coronal hole 44. This is most likely to occur tomorrow (15th), but with a slight chance of an early arrival late today. Quiet (Kp 0-1) geomagnetic activity is expected until this arrival, then becoming Active to G1/Minor Storm (Kp 4-5) as it occurs, with a slight chance of G2/Moderate Storms (Kp 6). Declining Quiet to Unsettled for days 3 and 4 (16th and 17th), with Active intervals and slight chance of G1/Minor Storms for day 3 (16th).

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Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at background levels. The high energy electron flux (greater than 2MeV) is expected to remain near background until after the arrival of the fast wind of coronal hole 44. The flux is then likely to increase Moderate to High from day 3 (16th). The associated 24 hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold for much of the period, but with a chance of reaching the Active threshold by the end of day 3 (16th), and then likely to reach the Active threshold during day 4 (17th).

Figure 1. Solar Analysis Valid 13/1930 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

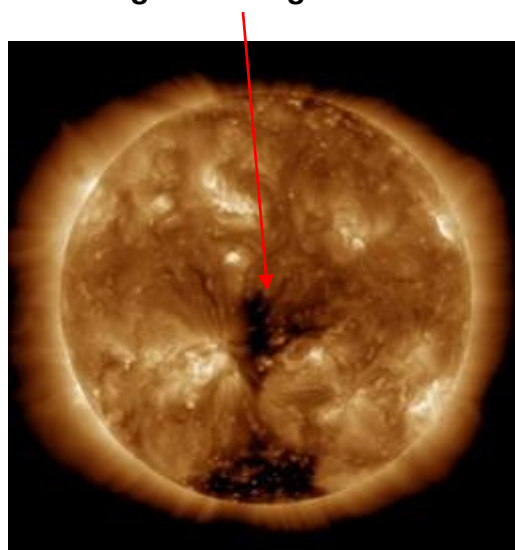
There are no Earth-directed CMEs.

Solar winds starting the four-day forecast period at slow-ambient levels before the arrival of the HSS related to coronal hole 44, most likely early tomorrow (15th). Solar winds are likely to reach 600-650 km/s and remain elevated through day 3 (16th). There is some uncertainty on the timing, with Enlil currently suggesting arrival through today, whilst STEREO A has seen both increased density followed by increased speed on the 12th. As STEREO A is currently observing conditions 2.7 days ahead of Earth, this corresponds to a HSS arrival late today or early tomorrow (14th/15th). Persistence would suggest arrival later on the 15th, however the coronal hole structure is markedly changed from the previous rotation; larger and more defined with its leading edge slightly further west.

Quiet (Kp 0-1) geomagnetic activity is expected until this arrival, then becoming Active to G1/Minor Storm (Kp 4-5) as it occurs, with a slight chance of G2/Moderate Storms (Kp 6). Declining Quiet to Unsettled for days 3 and 4 (16th and 17th), with Active intervals and slight chance of G1/Minor Storms for day 3 (16th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	60	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest SDO AIA 193 image showing CH44.



Radio Blackouts - X-Ray Flares:

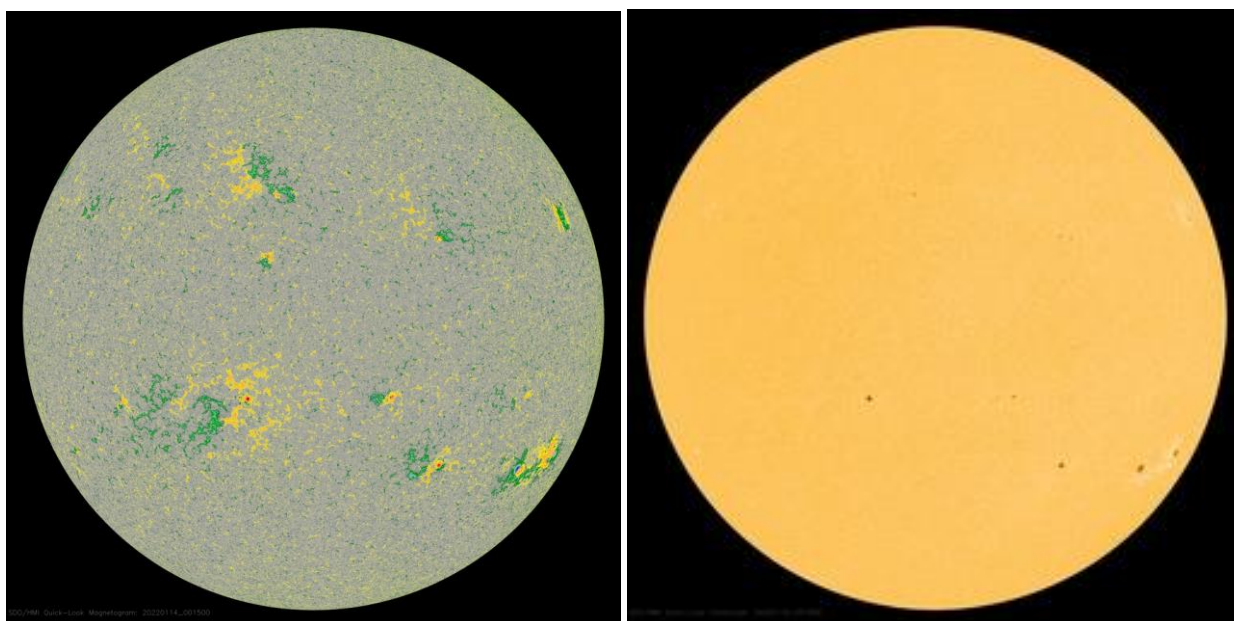
Solar Activity is currently Low with several of C-class flares observed in the past 24 hours. There are currently six active regions on the Earth-side, however no notable flares have been observed from these regions.

AR2924 remains the largest region, the most prominent region but also inactive, whilst slightly reducing in area over the past few hours as some intermediate spots have either disappeared or shrunk. AR2925 and AR2927 continue as small mature regions. AR2926 and 2928 both appear to be stable, despite 2928 developing some rudimentary penumbra on its trailing spot. AR2929 has faded to become plage. There are also notable areas of plage, including the NE and SE quadrants.

Through today the far-sided C-class flare source region, likely AR2921 from the previous rotation, is expected to rotate onto the visible disc. A further large far-side sunspot (AR2918) is also signaled to rotate onto the disc during day 3 (16th). This brings a slightly increased chance of M-flares (R1/R2 Blackouts) from tomorrow (15th) onwards.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	15	15	15
Very Active	R3 to R5 X Class	No	1	2	2	2

Figure 3: Latest SDO HMI Magnetogram (left) and intensitygram (flattened).



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	1	1	1	1
Very Active	$\geq \text{S3}$ *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly at background levels, just temporarily reaching moderate levels. Flux levels will remain below the alert level (1000 pfu) until after the arrival of the fast wind of CH44. This is forecast to occur tomorrow (15th) with a subsequent increase likely through day 3 (16th) but more especially through day 4 (17th) with alert levels likely to be reached.

The associated 24 hour electron fluence is expected to remain below the Active ($1\text{e}8$ integrated pfu) threshold for much of the period, but with a chance of reaching the Active threshold by the end of day 3 (16th), and then likely to reach the Active threshold during day 4 (17th). The Met Office REFM output is currently giving good guidance, showing the fluence gradually increasing whilst remaining below the Active threshold, during the first 3 days of the forecast period.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	10	40	60
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Met Office REFM Model.

